

**A NEW SUBGENUS, *FOOTERELLIA*, AND NEW DISTRIBUTION RECORDS
OF *NEASPILOTA* OSTEN SACKEN (DIPTERA: TEPHRITIDAE: TERELLIINI)**

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Abstract.—The subgenus *Footerellia* of *Neaspilota* is described based on *N. (F.) reticulata*, n. sp., from USA: Ohio and Michigan. It is unusual for the tribe Terelliini in having an extensively reticulate wing pattern. It breeds in flowers of *Coreopsis tripteris* L. (Asteraceae). Distributional data (new records or corrections) are given for three other species of *Neaspilota*: *N. floridana* is reported from the Bahamas, the first record of *Neaspilota* from the Neotropical Region; *N. achilleae* is recorded from Georgia; and *N. vernoniae* is reported from Kentucky, but not Newfoundland as previously reported. Updated couplets for the genera of Terelliini are also provided for the most recent key to Nearctic genera of Tephritidae.

Key Words: *Neaspilota*, Terelliini, Asteraceae, distribution, Bahamas, Georgia, Kentucky

The tribe Terelliini is a predominantly Old World (mostly Palearctic) group of 107 species divided among six genera, four of which have been reported to occur in North America: *Chaetorellia* Hendel (three introduced species); *Chaetostomella* Hendel (one native species); *Neaspilota* Osten Sacken (19 native species); and *Terellia* Robineau-Desvoidy (two native and three introduced species) (Norrbom et al. 1999a, b). The native Nearctic Terelliini have been relatively well studied taxonomically (Foote et al. 1993), especially the largest genus, *Neaspilota*, which was thoroughly revised by Freidberg and Mathis (1986). We were therefore rather surprised to discover a very distinctive new terelliine species from the Midwest, which breeds in flowers of *Coreopsis tripteris* L. (Asteraceae). It is unusual in having an extensive, reticulate wing pattern; most species of Terelliini have banded, spotted, or mostly or

entirely hyaline wings. This species, which we here describe in the new subgenus *Neaspilota* (*Footerellia*) as *N. reticulata*, n. sp., appears to be the sister group of the other species of *Neaspilota*. We also take this opportunity to report distributional information for three species of *Neaspilota* and to update the couplets concerning the Terelliini in the most recent key to Nearctic genera of Tephritidae (Foote et al. 1993) to incorporate changes in classification and from the introduction of species and genera.

UPDATES TO KEY TO NEARCTIC GENERA OF
TEPHRITIDAE AND KEY TO SPECIES OF
NEASPILOTA

Since the publication of the latest key to genera of fruit flies of America north of Mexico (Foote et al. 1993), three species of the Palearctic genus *Chaetorellia* have been introduced (*C. acrolophi* White & Marquardt and *C. australis* Hering for weed

biocontrol, and *C. succinea* (Costa) accidentally), as were two species of *Terellia* (*T. virens* (Loew) for weed biocontrol, and *T. fuscicornis* (Loew) accidentally) (Norrbon et al. 1999a). The three species formerly classified in the genus *Orellia* Robineau-Desvoidy were transferred to *Terellia* by Korneyev (1985), but this change was not included by Foote et al. The following couplets, which can be substituted for couplets 18–20 of the generic key of Foote et al. (1993), incorporate these changes. Figure numbers refer to Foote et al. (1993), not the present publication.

- 18. Posterior orbital bristle distinctly inclinate (fig. 44, a); first flagellomere rounded at apex dorsally; scutum with lyre-shaped dark gray pattern 18A
 - Posterior orbital bristle usually reclinate or absent, if inclinate, first flagellomere with dorsoapical point (*Rhagoletis acuticornis*) and/or scutum without lyre-shaped pattern (*Campiglossa pallidipennis*) 21
- 18A. Scutum with 2 pairs of dorsocentral bristles (one pre- and one postsutural); wing with 4 transverse bands *Chaetorellia* Hendel (3 introduced Palearctic spp.)
 - Scutum with 1 pair of dorsocentral bristles (postsutural); wing pattern variable 19
- 19. Anteroventral margin of gena with a few well-developed bristles larger than adjacent setae (fig. 45, a); wing with 4 transverse bands (fig. 175) *Chaetostomella* Hendel (1 sp., western U.S.)
 - Anteroventral margin of gena with only small, more or less equal sized setae (fig. 44, b); wing pattern variable 20
- 20. Node of vein Rs (at fork of R_{2+3} and R_{4+5}) dorsally with 1 to several setulae (fig. 47, a); scutum with small, circular, dark brown spot at base of acrostichal bristle (in species in N. America); abdomen usually with paired dark brown spots
 - *Terellia* Robineau-Desvoidy (2 native and 3 introduced Palearctic spp., widespread)
 - Node of vein Rs usually bare, rarely with 1–2 setulae; scutum without small, circular, dark brown spot at base of acrostichal bristle; abdomen yellow, mostly brown, with brown bands, or occasionally (2 spp.) with paired dark brown spots
 - *Neaspilota* Osten Sacken (20 spp., Alaska, southern Canada, widespread U.S., also Mexico and Bahamas)

Chaetorellia was recently revised by White and Marquardt (1989), and their key is the best means of identifying the three species introduced to North America. The two recently introduced species of *Terellia* differ from the other three species in North America (treated under *Orellia* in Foote et al. 1993) in having entirely hyaline wings. These two species are easily distinguished using the key of Freidberg and Kugler (1989: 166): *T. fuscicornis* is a large species (wing length 3.6–6.2 mm), with, as its name indicates, the first flagellomere dark brown; *T. virens* (wing length 2.2–3.8 mm) has entirely yellow antennae. These species also differ significantly in genitalic characters (see Freidberg and Kugler 1989, White 1989).

The following couplet can be added to the beginning of the key to species of *Neaspilota* in Foote et al. (1993) in order to include *N. reticulata*. The figure numbers in the second part of the couplet refer to Foote et al. (1993), not the present publication.

- A. Wing pattern reticulate, predominantly dark with hyaline spots (Fig. 2). Male fore tarsus symmetrical. Female with aculeus relatively broad, less than 4 times as long as wide (Fig. 4A). Midwest; infesting flowers of *Coreopsis* (*Footerellia*, n. subgen.) *reticulata*, n. sp.
- Wing predominantly or entirely hyaline, at most with 3 bands or series of spots and some faint smaller spots (fig. 49, 266, 267). Male fore tarsus usually asymmetrical (fig. 275–282). Aculeus more than 4 times as long as wide. Widespread; hosts various 1

**Genus *Neaspilota* Osten Sacken
Footerellia Norrbom and Foote,
new subgenus**

Type species.—*Neaspilota reticulata*, n. sp.

Diagnosis.—The single known species of this subgenus is easily distinguished from other *Terelliini*, including the other two subgenera of *Neaspilota*, by its extensive, reticulate wing pattern (Fig. 2), which has more dark than hyaline areas. The largest of the hyaline areas do not extend over more than 2 wing cells each. Many other

Table 1. Characters used in phylogenetic analysis of *Footerellia*.

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1. Posterior orbital seta—0) reclinate; 1) inclinate.
 2. Scutum with dark, lyre-shaped pattern—0) no; 1) yes.
 3. Male fore tarsomere 5—0) symmetrical; 1) asymmetrical, with "comb", or at least several, short, stout, subequal setulae anteroapically; 2) as state 1, but with anteroapicalmost setula of "comb" larger than others.
 4. Proctiger with lateroventral tuft of setae—0) no; 1) yes.
 5. Distiphallus with apex of basal (non-glans) part with lappet-like projection—0) no; 1) yes.
 6. Glans with "apicodorsal rod"—0) yes; 1) no.
 7. Spermathecae relatively dark—0) no; 1) yes.
 8. Spermatheca shape—0) rounded apically; 1) truncate.
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Terelliini have extensive wing patterns, but with either isolated dark spots or distinct bands, broadly delimited by large hyaline areas. *Footerellia* further differs from other Terelliini, except other *Neaspilota*, in lacking a subapical lobe ("apicodorsal rod") on the glans of the phallus, and from the other subgenera of *Neaspilota* in having a symmetrical male fore tarsus and a broader aculeus. The type species, *N. (F.) reticulata* is more likely to be confused with species of Tephritini, such as *Euaesta* or *Neotephritis*, or Xyphosiini, such as *Gymnocarena*, which have similar wing patterns. The Tephritini differ as follows: postocular setae mixed black and white and varying in size; scutal color pattern absent, or if present, not lyre-shaped; and posterior orbital seta usually reclinate or absent (in New World Tephritini, convergent only in a few species of *Campiglossa*, which further differ from *N. reticulata* in having only 2 frontal setae

and the proboscis geniculate). *Gymnocarena* species differ from *N. reticulata* in having the posterior orbital seta reclinate and the scutum unicolorous, without the lyre-shaped pattern.

Etymology.—The name of this subgenus, which is feminine, is a combination of the last name of Richard H. Foote, in recognition of his vast contributions to the taxonomy of the Nearctic Tephritidae, and *Terellia*, the type genus of the tribe to which this subgenus belongs.

Remarks.—We conducted a preliminary cladistic analysis of the phylogenetic relationships of *Footerellia* based on the characters listed in Table 1 and the taxa listed in Table 2. For simplicity, only some species of the other two subgenera of *Neaspilota* were included. The matrix of Table 2 was analyzed using Hennig86 (ie* option), which resulted in four equally parsimonious trees (length 13 steps, consistency index = 0.69, retention index = 0.73). One of these trees is shown in Fig. 1. Characters 3 and 6 may have evolved differently than shown; character 3.2 could have arisen in *Neaspilota vernoniae* and in other *Neaspilota* species, and character 6 could have evolved in the Tephritinae and reversed in the other Terelliini. The other three trees differ from Fig. 1 only in the relationships of the species of *Neaspilota* (*Neaspilota*); in one tree the positions of *N. vernoniae* and *N. floridana* are reversed, and in the other two trees either *N. vernoniae* or *N. floridana* forms an unresolved trichotomy with the rest of *Neaspilota* (*Neaspilota*) and *Neorel-*

Table 2. Character state distributions in taxa used in phylogenetic analysis. See Table 1 for explanation of character numbers and states.

	12345678
Trypetinae	00000000
other Tephritinae	00000100
other Terelliini	11001000
<i>N. (Footerellia) reticulata</i>	11000110
<i>N. (Neaspilota) vernoniae</i>	11200110
<i>N. (Neaspilota) floridana</i>	11110110
other <i>Neaspilota</i> , s.str.	11210110
<i>N. (Neorellia) callistigma</i>	11101111
<i>N. (Neorellia) isochela</i>	11001111
other <i>Neorellia</i>	11100111

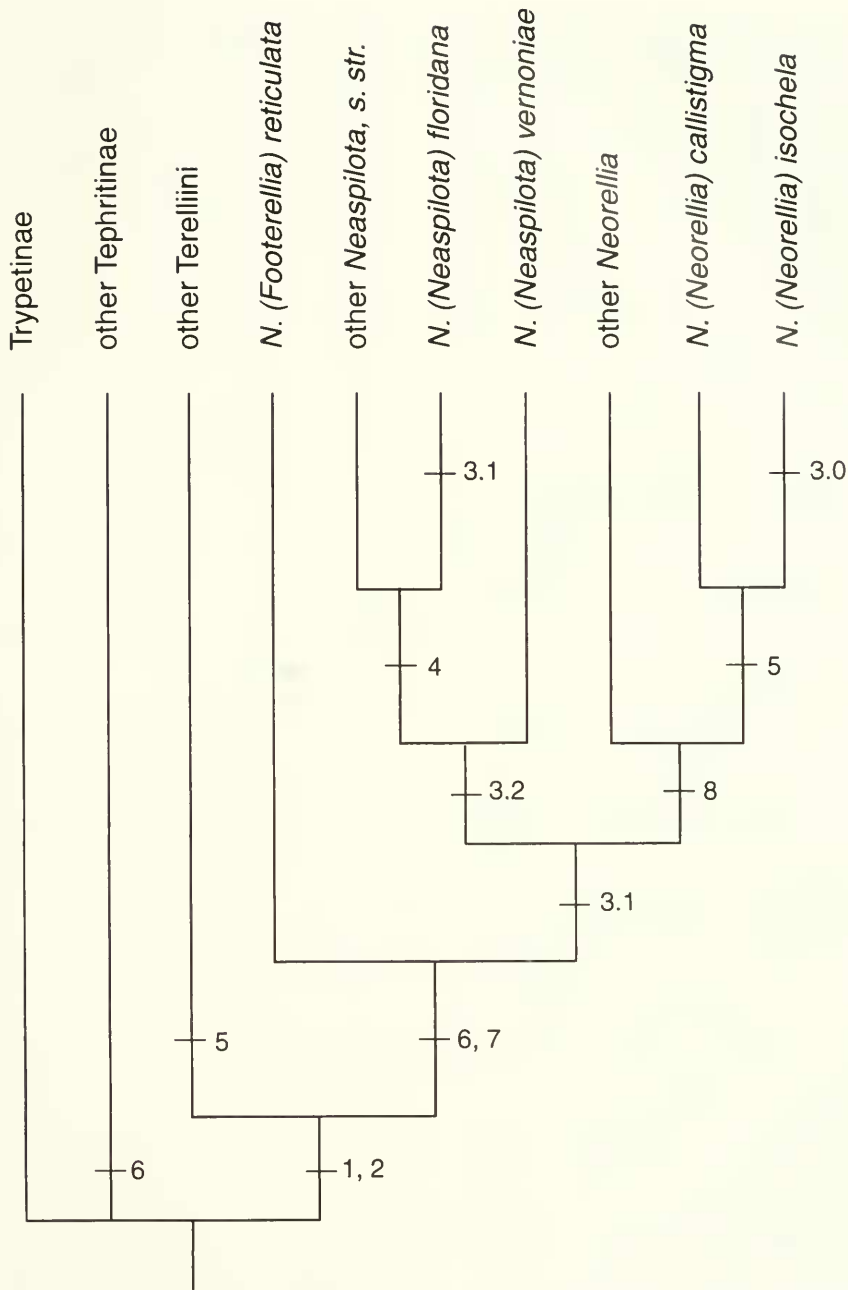


Fig. 1. Possible phylogenetic relationships of *Neaspilota (Footerellia) reticulata*. One of four equally parsimonious trees that resulted from cladistic analysis (see text). Character numbers refer to Table 1.

lia. In all of these trees, *Footerellia* was hypothesized to be the sister group of the rest of *Neaspilota*. We consider these results preliminary, however, because we have not studied the other Terelliini in detail. We did

not include some characters used by Freidberg and Mathis (1986) in the matrix because their polarities could not be resolved. For example, *Footerellia* possesses several characters that Freidberg and Mathis (1986)

considered diagnostic for *Neaspilota*, s. str.: head more rounded than quadrate, height to length ratio greater than 1.25 and frontofacial angle greater than 120° , lower facial margin not strongly projected; frons sparsely setulose; arista mostly bare; and aculeus tip with sensilla closely approximated. The number of large anepisternal setae is variable. All of these characters are fairly variable in Tephritinae, for example, within the genus *Terellia*, head shape varies considerably and the arista varies from micropubescent to bare. Freidberg and Mathis (1986) considered the setulose frons a synapomorphy for *Neaspilota*, s. str., but *N. (F.) reticulata* has considerably fewer setulae than the species of that subgenus and the homology of this character is therefore uncertain. Further analysis of the entire Terelliini, which was beyond the scope of this study, should be conducted to confirm the phylogenetic position of *N. (F.) reticulata*.

Neaspilota reticulata clearly appears to belong in the tribe Terelliini based on its having the two character states considered synapomorphies for this group by Freidberg and Mathis (1986): posterior orbital seta inclinate (character 1); and scutum with dark, lyre-shaped pattern (character 2). It also has vein R_{4+5} bare, which Korneyev (in press) considered another synapomorphy of the Terelliini. Like the other two subgenera of *Neaspilota*, *Footerellia* differs from other Terelliini in lacking a subapical lobe ("apicodorsal rod") on the glans of the phallus (character 6), which Korneyev (in press) considered an apomorphy that also occurred independently in the other tribes of Tephritinae. *Footerellia*, *Neaspilota*, s. str., and *Neorellia* also have relatively dark spermathecae (character 7), which is probably a synapomorphy.

Footerellia lacks the character state that Freidberg and Mathis (1986) considered a synapomorphy for *Neaspilota*, s. str. + *Neorellia* in that the male of *N. (F.) reticulata* does not have asymmetrical fore tarsi as in most other species of *Neaspilota* (character 3). But it should be noted that

there is reversal in this character in one species of *Neorellia* (*N. isochela*) according to Freidberg and Mathis' hypothesis of relationships, which was confirmed by our analysis. *Footerellia* also lacks the character state that Freidberg and Mathis (1986) hypothesized as a synapomorphy for *Neorellia*; the spermathecae are rounded apically, not truncate (character 8). The male of *N. (F.) reticulata* does not possess two apomorphic character states that occur within the subgenus *Neaspilota*. It does not have a lateroventral tuft of setae on the proctiger (character 4), which occurs in the three species of *N. (Neaspilota)* other than *N. vernoniae*, nor does it have the anteroapicalmost seta of the fore tarsal "comb" enlarged as in the three species of *N. (Neaspilota)* other than *N. floridana* (*Footerellia* entirely lacks the comb). Freidberg and Mathis (1986) considered the former character a synapomorphy for the subgenus *Neaspilota*, and in combination these two characters support this group as monophyletic in two of the four trees that resulted in our analysis, however, two additional trees with the relationships of *N. (Neaspilota)* unresolved were equally parsimonious. Further study is thus needed to confirm that this subgenus is monophyletic.

One additional character used in this analysis is worthy of mention. *Footerellia* lacks the lappet-like lateral extension of the apex of the basal (non-glans) part of the distiphallus (character 5) as do most other species of *Neaspilota*. This lobe is present, but variable in size, in several species of *Neorellia* and is present in most other species of Terelliini. Korneyev (in press) interpreted this structure as homologous with the membranous basal lobe of the glans present in many Trypetinae, but due to its different structure, this homology seems uncertain. Korneyev considered this character state to have been present in the ground plans of both the Tephritinae and Terelliini, in which case its loss could be interpreted as a synapomorphy for *Footerellia* + *Neaspilota* (s. str.) + most species of *Neorellia*,

but our analysis suggests independent evolution in some *Neorellia* and other Terelliini.

The reticulate wing pattern in *N. (F.) reticulata* is probably autapomorphic, although similar patterns occur within many other tribes of Tephritinae and even in some Trypetinae, Phytalmiinae and Blepharoneurinae. Other *Neaspilota* species and other Terelliini have hyaline, spotted, or banded wings. Given the extreme variation in wing pattern that occurs within the Tephritidae it is difficult to determine whether or not the pattern in *Footerellia* is homologous with similar types of patterns in other taxa.

***Neaspilota (Footerellia) reticulata*
Norrbon and Foote, new species**

Holotype.—♀ (USNM51657) USA: Ohio: Portage Co.: Towners Woods Park, 1.0 mile E. Kent, reared from *Coreopsis tripteris* L., emerged 27 May 1984, B. A. Foote, Biol. note no. 8021. (USNM = National Museum of Natural History, Smithsonian Institution, Washington, DC.)

Paratypes.—USA: Ohio: Portage Co.: Towners Woods Park, 1.0 mile E. Kent, reared from *Coreopsis tripteris* L., emerged 15 Sep 1994, 1 ♀ with puparium (USNM51656); same, except emerged 30 Sep 1996, 2 ♂ (USNM51724–25). Michigan: Ingham Co., Dansville St. Wild. Area, 17 Jul 1987, J. Jenkins, Malaise trap baited with CO₂, 1 ♀ (USNM51655).

Description.—Most setae and setulae golden. **Head:** In lateral view 1.28–1.45 times as high as long; ventral facial margin not strongly produced, angle between frons and face 130–140°. Frons with 2–4 setulae medially; 3 frontal setae, anterior pair sometimes smaller than posterior 2; 2 orbital setae, posterior seta golden, nearly as large as anterior seta, and strongly inclinate. Face slightly silvery microtrichose. Gena in lateral view 1.0–1.4 times as high as height of first flagellomere. Postocellar seta and postocular setae slightly more whitish than other setae, very slightly lanceolate; postocular setae uniform in color and size.

Arista 1.4 times as long as rest of antenna, mostly bare, minutely pubescent at base. Proboscis capitate. **Thorax:** Scutum with dark “lyre-shaped” pattern, obscured by dense microtrichia, but posteromedial yellow area clearly extended anteriorly to dorsocentral seta; without any additional dark brown spots at bases of setae. Setulae golden and acuminate, a few on anterior margin and on postpronotal lobe more whitish and very slightly lanceolate. Microtrichia whitish anteriorly, golden posteriorly. Subscutellum, mediotergite, most of laterotergite, parts of anepimeron and meron, and most of katapisternum (except margins) also with dark ground color. One pair of dorsocentral setae, aligned with postsutural supra-alar seta. Anepisternum with 1–2 large setae in posterior row. Other thoracic chaetotaxy as described for *Neaspilota* by Freidberg and Mathis (1986). Male fore tarsus symmetrical, without modified setae. **Wing** (Fig. 2): With extensive reticulate pattern, mostly dark brown with hyaline spots, infusate areas fainter gray-brown in basal third of wing. Dark brown areas include broad area from pterostigma extended into cell cu₁, covering crossvein R-M, and subapically a large area primarily in cells r₂₊₃ and r₄₊₅ as long as broad and without hyaline spots in its center. Cell r₁ with two hyaline basal marginal areas extended into cell r₂₊₃, and with 1–2 small subapical hyaline spots. Cell r₂₊₃ with round hyaline spot near apex of vein R₂₊₃ and a subapical hyaline spot near posterior margin, sometimes fused with spot in cell r₄₊₅. Cell r₄₊₅ with 2 subbasal spots (a large one anterior to crossvein DM-Cu and a smaller one slightly more distally) and 2–4 subapical spots. Pterostigma 2.0–2.5 times as long as wide. Node of Rs and vein R₄₊₅ without setulae. **Abdomen:** Tergites entirely yellow, without dark spots. Setulae uniformly golden. **Male genitalia:** Epandrium and surstyli relatively broad versus high in posterior view (Fig. 3B), nearly circular; lateral surstylus short, strongly mesally curved. Proctiger (Fig. 3A) with setae evenly distributed. Glans



Fig. 2. Wing of *Neaspilota* (*Footerellia*) *reticulata* (Michigan paratype).

(Figs. 3C–D) relatively stout, without basal membranous lobe, and without sclerites in vesica; acrophallus short, stout, with sharp subapical turn (Fig. 3C). *Female genitalia*: Aculeus (Fig. 4A) relatively broad, about 3.3 times as long as wide; tip relatively short and stout, evenly tapered, entire; 2 larger sensilla separated by approximately length of sensillum. 2 spermathecae (Fig. 4B) pear-shaped, dark brown.

Etymology.—The name of this species, the Latin adjective *reticulata*, refers to its wing pattern.

Biology.—The second author has reared this species from flowers of *Coreopsis tripteris* L. (Asteraceae, tribe Heliantheae). This is the first confirmed record of a terelliine species breeding in this genus. Freidberg and Mathis (1986) listed *C. calliopsidea* (DC.) Gray as a suspected host of *Neaspilota wilsoni*, but Goeden (1989) considered it a doubtful host. No other terelliine species have reported hosts in the tribe Heliantheae. The four species of *Neaspilota* (*Neaspilota*), except for two records for *N. floridana* considered doubtful by Freidberg and Mathis (1986), so far as known breed only in species of *Vernonia* (tribe Vernonieae). Species of *Neaspilota* (*Neorellia*) have hosts in several tribes, but breed predominantly in species of the tribe Astereae (Goeden 1989). The North American spe-

cies of *Chaetorellia*, *Chaetostomella*, and *Terellia* breed in species of Cardueae.

DISTRIBUTIONAL RECORDS FOR *NEASPILOTA*

The previously published distributional data discussed below are from Freidberg and Mathis (1986) or Foote et al. (1993).

Neaspilota achilleae Johnson

The following records are the first from Georgia and eastern Newfoundland for *N. achilleae*, which is known from coastal areas from Newfoundland to Alabama. The male from Newfoundland was misidentified as *N. vernoniae*. CANADA: NEWFOUNDLAND: Terra Nova Nat'l. Park, 6 Jul 1961, C. P. Alexander, 1 ♂ (USNM51002). USA: GEORGIA: 14 mi. N Folkston, 10 Apr 1989, J. E. Swan, 1 ♀ (University of Guelph).

Neaspilota floridana Ibrahim

The following records extend the known range of this species, previously reported from Kansas, Missouri, Arkansas, Texas, Louisiana, Pennsylvania, Virginia, North Carolina, Georgia, and Florida. BAHAMAS: Grand Bahama Island, Freeport, 20–27 Jun 1987, W. E. Steiner, M. J. & R. Molineaux, Malaise trap in Caribbean pine and palmetto scrub, 1 ♀ (USNM51110). USA: Illinois: Bond Co.: 0.5 mi W Dudleyville,

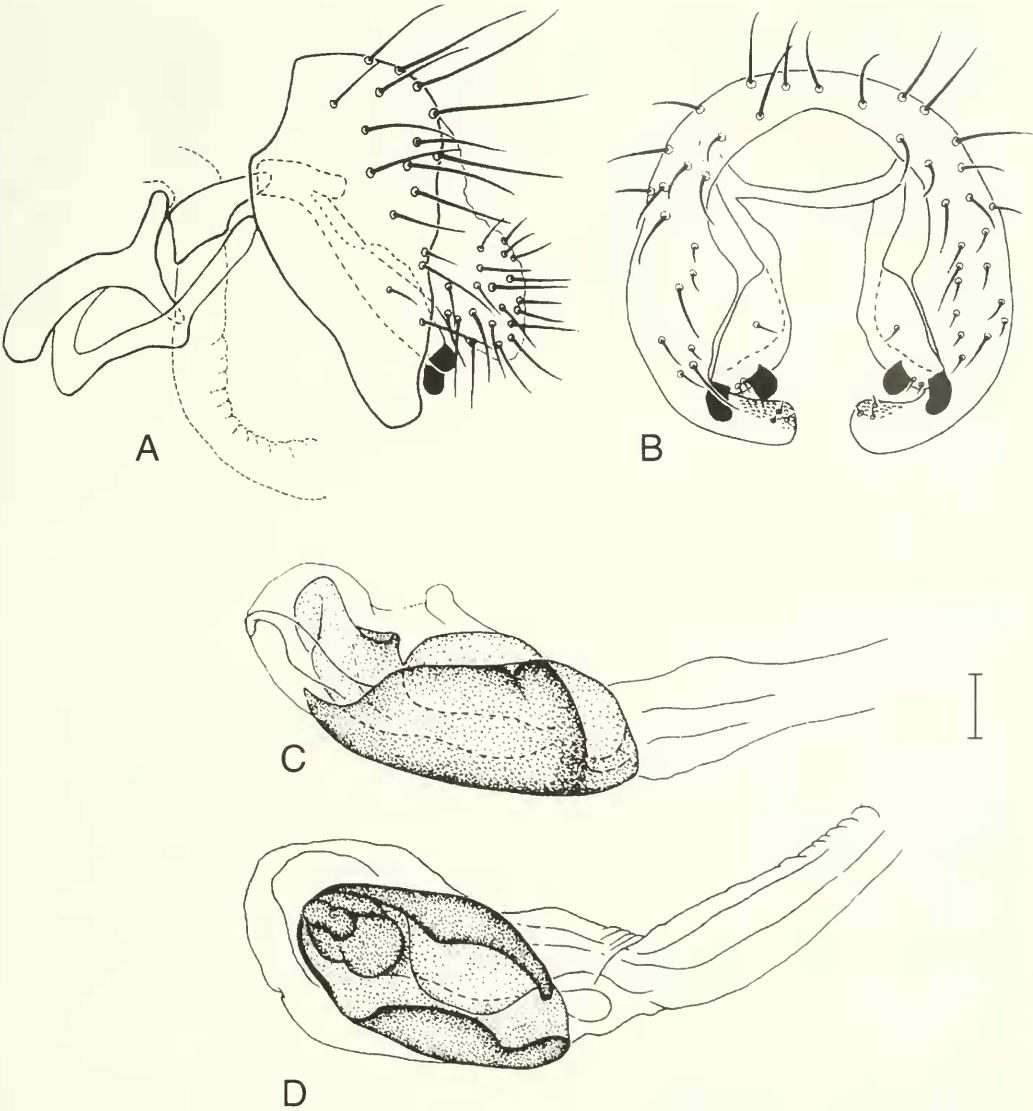


Fig. 3. Male genitalia of *Neaspilota (Footerellia) reticulata* (Ohio paratype). A, Lateral view of epandrium, surstyli, proctiger and base of phallus. B, Posterior view of epandrium and surstyli. C–D, Glans in ventral and lateral views. Bar = 0.10 mm.

15 Aug 1979, E. A. Lisowski, 1 ♂ (USNM51658); Clinton Co.: 1.5 mi NE Albers, 12 Aug 1980, E. A. Lisowski, 1 ♂ 1 ♀ (USNM51659–60); Monroe Co.: 3 mi ESE New Design, 13 Aug 1980, E. A. Lisowski, 1 ♂ (USNM51661). The Bahamas record, notable as the first record of *Neaspilota* from the Neotropical Region, ought to be confirmed at the species level by the collection and identification of male speci-

mens. The Illinois specimens were retained from larger series in the Illinois Natural History Survey.

Neaspilota vernoniae (Loew)

This species was previously known from an arc from Kansas, Nebraska and Iowa to Michigan to Massachusetts and New Jersey, with one outlying record from Newfoundland which is erroneous. It should be noted

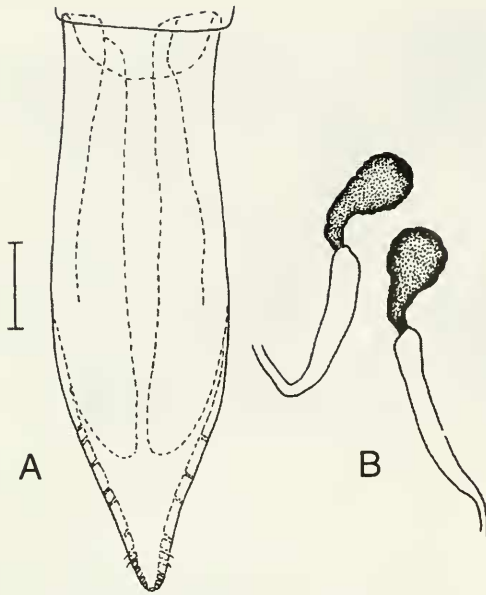


Fig. 4. Female genitalia of *Neaspilota* (*Footrellia*) *reticulata* (Michigan paratype). A, Aculeus. B, Spermathecae. Bar = 0.10 mm.

that the distribution map in Foote et al. (1993, map 36) has the color of the dots erroneously reversed for *N. brunneostigmata* Doane and *vernoniae*, and omitted the valid record of *vernoniae* from Westport Factory, Massachusetts reported by Freidberg and Mathis (1986). The Newfoundland record was based on the misidentified male of *N. achilleae* in the USNM listed above. Also in the USNM there is one male of *N. vernoniae* with the following data: KENTUCKY: Fayette Co., 15 Jul 1980, J. Millstein (USNM51662). This record extends the known middle part of the range of this species southward by approximately 400 km.

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